

Universal Design for Learning in Postsecondary Education

Reflections on Principles and Their Application

David H. Rose

Wendy S. Harbour

Catherine Sam Johnston

Samantha G. Daley

Linda Abarbanell

Written by the teaching staff of the course T-560: Meeting the Challenge of Individual Differences, at the Harvard Graduate School of Education, this chapter reflects on potential applications of universal design for learning (UDL) in university courses, illustrating major points with examples. The authors emphasize the ongoing developmental nature of the course and UDL principles as tools or guidelines for postsecondary faculty, rather than a set of definitive rules. UDL is proposed as a way to address diversity and disabilities in higher education classrooms by shifting the burden of being flexible and responsive from the student to the curriculum.

Although the concept of universal design is now familiar to many educators, its application in education lags far behind its application in the built environment. In this chapter, we illustrate the principles of what we call universal design for learning (UDL) in a university course. This chapter is essentially an excerpt from an article that appeared in the *Journal of Postsecondary Education and Disability*. The longer article includes a discussion of the roots of UDL in cognitive neuroscience.

This chapter is an excerpt from an article originally published as D. H. Rose et al. (2006). Universal design for learning in postsecondary education: Reflections on principles and their application. *Journal of Postsecondary Education and Disability*, 19(2): 135–151.

Universal design focuses on the elimination of barriers through initial designs that consider the needs of diverse people rather than the overcoming of barriers later through individual adaptation. Because the intended users are whole communities, universally designed environments are engineered for flexibility and designed to anticipate the need for alternatives, options, and adaptations to meet the challenge of diversity. UDL is one part of the overall movement toward universal design. The term emphasizes the special purpose of learning environments: They are created not only to transmit information or to shelter but also to support and foster the changes in knowledge and skills that we call learning. Although providing access to information or to materials is often essential to learning, it is not sufficient. UDL requires that we design not only accessible information but also an accessible pedagogy through

- multiple means of representation;
- multiple means of expression;
- multiple means of engagement.

THE APPLICATIONS OF UNIVERSAL DESIGN FOR LEARNING IN A UNIVERSITY COURSE

In this section we describe our semester-long course called T-560: Meeting the Challenge of Individual Differences, offered at the Harvard Graduate School of Education. In the 2004–05 academic year, ninety-three graduate students were registered (mostly master's students, but also doctoral students), an enrollment that is quite large for Harvard's Graduate School of Education. The students who take the course are diverse in background and interests, and a significant number have cross-registered from other colleges (e.g., law, public health) or other universities (e.g., the Massachusetts Institute of Technology). In general, however, the majority of students come from three areas within the Graduate School of Education: human development (especially those interested in mind, brain, and education), technology in education, and teaching and curriculum development. Many students interested in disabilities and special education also take the course, although there are no particular degree programs or concentrations in those subjects at Harvard University.

From the outset, we acknowledge that T-560 is not a perfect demonstration of UDL. Many aspects of the course would fail to meet any standard for UDL. Like UDL itself, the course is a work in progress, not a destination. We offer our observations merely as travelers on a journey, and we look forward to your suggestions as fellow travelers. Furthermore, we encourage readers not to take our observations as rules or steps to follow. UDL emerges differently in different contexts. The ideas here are merely a set of starter tools, not a complete vision, and we expect to learn a great deal as we travel ahead and incorporate additional advice, research, and experiences.

Goals of T-560

Like many postsecondary courses, T-560 originally began with goals that were largely ambiguous. Set in the context of a university, the implicit goal was to teach information and ideas, specifically about applying neuroscience to education. Its meth-

ods were completely traditional, including lectures and readings that were selected to transfer facts and ideas from the instructor and authors to eager (and sometimes not so eager) students.

Over time, that course content migrated somewhat, as did its instructional methods, and finally its goals. The current course description reads as follows:

In the era of No Child Left Behind and IDEA [Individuals with Disabilities Education Act], the challenge of individual differences faces every teacher, administrator, and curriculum designer. The media and materials of the general education curriculum, once designed primarily for a narrow and illusive group of “regular” students, must now ensure results for students with a much wider range of abilities and disabilities. This course will explore recent advances that are critical to meeting this challenge. The first half of the course will address recent research in the neuroscience of learning—providing a new framework for understanding the range of individual differences that must be addressed. The second half will address recent advances in the design of educational media and technologies—advances that meet the challenge of individual differences through universal design.

With this basic information about the outline of the course, it is instructive to consider its goals from a UDL perspective, including consideration of three aspects of the goals following the three primary principles of UDL.

First, there is the obvious goal: teaching information. The course is clearly intended to teach information on a variety of topics: neuroscience, learning in the brain, individual differences in the way our brains learn, the limits and strengths of various educational media for teaching, as well as the ways in which they can be individualized. This goal has remained fairly consistent over the last decade. The first principle of UDL reminds us that information must be presented in multiple ways in order for that goal to be achieved for a wide range of students.

But the UDL framework requires a broader understanding of goals and objectives. The framework reminds us that it is not enough for students merely to acquire information; they must also have some way to express what they have learned and some way to apply that information as knowledge. Only in its expression is knowledge made useful. Thus, the goals for the course must have an expressive component. It is important that students not only have information but also know how to apply the information in appropriate settings, including the kinds of work they will likely perform during their lives ahead. The second principle reminds us that there must be multiple means for expressing their knowledge and multiple means for learning the skills that will underlie that expression.

The third UDL principle reminds us also that there is an affective component to reaching any goal. While the explicit goals of a course tend to focus on the first two principles—the knowledge students will learn and the skills to express that knowledge—the third is just as critical. Students will never use knowledge they don’t care about, nor will they practice or apply skills they do not find valuable. Therefore, another goal of the course is affective. We want students to be engaged fully in learning the content, to be eager to apply what they know, to leave the course wanting to learn even more, and to want to apply their knowledge everywhere. Unfortunately,

we currently do not evaluate this third goal systematically enough. As members of the teaching staff for T-560, we do conduct regular weekly check-in discussions with each other before and after classes to talk about our individual observations, engagements, or motivations with that week's material, as well as any feedback or concerns from students. We informally assess student engagement through observation during classes and discussions, as well as through formal written course evaluations mandated by the Harvard Graduate School of Education. Yet ongoing evaluation of engagement and motivation remains a challenge.

Applying Universal Design for Learning Principles to Course Lectures

Typical courses in universities are dominated by two types of media: lectures and textbooks. It is legitimate to ask whether such a prominent position is warranted: Are lectures and textbooks effective media for instruction? Not surprisingly the answer is, it depends. While lectures and textbooks play an important role in instruction everywhere, both of them are ineffective for some students in all content areas and for all students in some content areas.

While that caution is worth stating at the outset, we are not going to try to slay that dragon here. At this time, and for the immediate future, it is a given that universities will use lectures and textbooks as the predominant means of mass instruction. And so lectures and books are very central to T-560, too. For that reason, we will begin our discussion of the course materials with them, highlighting how they are modified and used within the context of UDL. But it is important to clarify that lectures and books are presented within a somewhat different overall context in our course. The lectures and readings, as well as other media and activities, are embedded in a course Web site that forms the primary *container* or *backbone* of the course. Elements of this site will be described throughout this section, and the site itself is discussed in more detail later.

First, it is important to reflect on the strengths of lectures. Why are they important in postsecondary education? What is important to capture or save in any form of alternative representation? The strengths of a lecture derive from the enormous expressivity of the human voice. It is not the content or language itself—neither the semantics nor syntax—that is uniquely powerful; in fact, those aspects of a lecture are often conveyed more accessibly in a printed version of the lecture. What sets lectures apart is the enormous expressive capacity of spoken language, including its ability to stress what is significant and important, to clarify tone and intent, to situate and contextualize meaning, and to provide an emotional background. The feeble use of graphic equivalents to indicate significance (e.g., exclamation points and italics) cannot match the ability of spoken language to convey affect, such as irony or scorn, or to emphasize for clarity. This is why when a printed speech is read aloud, the power of language usually evaporates for any audience, unless the speaker is a gifted reader or actor. Speech coaches usually discourage public speakers from reading speeches because the natural expressivity of spoken speech is difficult to mimic when text has been provided in written form. It is not only the sounds of speech that lend meaning, clarity, and emphasis; many speeches and lectures are embedded in a full multimodal display. Good lecturers use facial expression, gesture, and body motion to further

convey meaning and affect. Moreover, lecturers frequently combine voice with additional media, such as PowerPoint slides. Altogether, this is a rich multimedia experience that overpowers the expressive strength of written text.

For these reasons, and to meet expectations of students and the university, lectures play an important role in T-560. Nevertheless, their limitations as an instructional medium are obvious. For some students (especially those who are deaf) lectures are completely inaccessible in their raw form. For many others the words are accessible because they can be heard and their meanings recognized, but they raise barriers of different kinds, stemming principally from high demands on linguistic and cognitive abilities, including memory, attention, and the amount of background knowledge they assume. In T-560, we use multiple strategies in our efforts to overcome the limitations and differential demands that lectures present.

First, in deference to the first principle of UDL, we give alternative representations of the lectures. Several types of alternatives are provided, differing in the kinds of problems they seek to address, the ease of implementation, and the kinds of technologies they require (from no-tech to high-tech). For example, the lecture's content is made available in alternate sensory modalities. The university provides sign language interpreters whenever there is a deaf student or teaching assistant in the class, as there has been for the last three years. Good interpreters capture not only the semantics of what they hear but also, through body movements, facial expressions, and gestures, the affect and stress. In addition, the lecturer attempts (not always consistently) to describe the visuals. At this time, this is the only real adaptation of the lecture we provide for students who are visually impaired or blind.

Second, we videotape each lecture in its entirety and post that video on the course Web site, where it can be accessed at any time. This permanent recording of the lecture is an alternative representation, which has several uses. For many students, it is convenient to access the recording of the lecture at any time of day or night, and a good backup if they are late or absent from class. For other students, the information in online lectures is much more accessible than the live version. Students for whom English is a second language or who have a wide variety of language-based disabilities, for example, find that the linguistic demands of understanding a live lecture are steep. For some of them, the flexibility of the video version is superior because it can be reviewed at any time to fill in gaps, stopped and started to hear difficult segments repeated, and even replayed in its entirety. Finally, for other students, the length and passivity of lectures and their demand for sustained attention and concentration are significant barriers that render lectures ineffective. Lectures are inherently evanescent and impermanent. The linear, one-time-only stream of a lecture is highly demanding on concentration and executive abilities. Lapses are inevitable and create difficult-to-repair gaps in a lecture's structure and meaning. For some students, therefore, the online video presentation is especially helpful because it allows them to articulate the larger whole of the lecture into manageable chunks or to replay segments that have been missed during lapses in concentration or attention. In truth, however, the videos of lectures are not used that much by the typical student in T-560. They are a fallback that is essential for some students but are far too time consuming, low in quality, and passive for most. It is interesting and important to note, for example, that in



spite of all lectures being available on the course Web site in digital video (and thus very convenient for viewing anytime and anywhere), students overwhelmingly come to class anyway.

Third, and perhaps most interestingly, we collect student notes from the lecture and display them for everyone in T-560. This may seem both time consuming and redundant, especially in light of the online video availability, but we have found this simple technique to be enormously beneficial and a wonderful example of the unexpected benefits of universal design. While it is possible to have volunteer or paid note-takers as an accommodation for students with disabilities, we have found these unsatisfactory in many instructive ways. In brief, "professional" note-takers are typically first-time students in the course, and their own skills at making sense of things are highly variable. Since their background knowledge, interests, and learning preferences often differ considerably from the disabled student for whom they are taking notes, their notes are often poorly directed, sampled, or leveled. Instead, we have hit on a very simple alternative. Each week, several students (in our case, five or six per lecture) are responsible for taking notes on the lecture, including whatever discussion happens. Within several days, they are required to send their notes to a teaching assistant, who posts them on the course Web site. The notes are then available to everyone, regardless of their disability or lack thereof. Though the notes are not graded, they are required as part of a student's participation grade.

There are several unexpected benefits of this note-taking process. First, the notes are more universally designed than the lecture itself; that is to say, different students capture and express very different content from the lecture, and they represent it in very different ways. In addition, despite being ungraded, students are highly engaged with the notes, responding to student notes in online discussions on the course Web site and using them as examples during class lecture. The variance in T-560 notes is astonishing. Some students post notes that are almost perfect linear outlines of the lecture. Some of these are very short and succinct with bullet outlines only, while others are much longer, more expressive, and expansive. Others are different in kind. For example, some students do not outline the talk at all and are much more anecdotal than taxonomic, capturing more of the stories of the lecture than its structure. That is only the beginning of the variation. Some students take very graphic notes instead of ones that rely primarily on text. Their notes range from doodles that accompany text, to heavy use of illustration and visual highlighting that clarify and connect parts of the text, to notes that are literally superimposed on the PowerPoint slides of the lecture, to full-scale visual representations of the main ideas and concepts in the lecture that have almost no words, just labels. The latter are often a big hit with other students who find them immediately a strong complement to the outline view. A second benefit derives from the public posting of these notes. Students, seemingly already engaged with the notes, recognize that their notes are about to become public to their peers. As a result, they often enhance the notes in various ways: by bringing in additional information, commentary, or questions; adding images or drawings; adding multimedia (like video or sound); or preparing the notes in a particularly cogent and clear way. We have never requested this kind of enhancement. Instead, there is a natural contagion of enthusiasm among the note-takers, who view notes from the previ-

ous lecture as a way of preparing to take their own. In fact, they learn to take better notes by informally mentoring each other.

Last, the point of universal design quickly becomes clear to every student, as the kinds of notes they take and what they learn from a given lecture often differ greatly from those of their classmates. Even though the lecture ostensibly conveys the exact same content for all ninety-three students, its reception is highly variable. Students perceive, understand, and prioritize different things within the same lecture. This is often especially interesting (and a big relief) to students who have been told they cannot take notes because of a disability (e.g., having a learning disability or brain injury, being deaf or hard of hearing). Though they may initially dread this aspect of the course requirement because of preexisting beliefs about what constitutes good or acceptable notes, they often quickly realize that their notes will be as good as their classmates' notes. Last year, one student told a T-560 teaching assistant that she felt more like a true member of the class, learned a lot about herself, and gained new insights into her learning disability and what it meant for her learning, simply because of the T-560 note-taking system.

Thus far we have talked about three different representations of the lecture: an alternative sensory presentation, like American sign language; a reviewable alternative in the form of Web-based videos; and multiple notes shared among students. There are actually many other ways to provide alternative means of support within a lecture. Following is one more example.

Cognitively, a lecture places many demands on students. For example, a lecture's structure is generally much more implicit than its textual counterpart. Missing are the explicit reviewable divisions into visible chunks like sentences, paragraphs, and chapters; the structural support provided by explicit and multiple levels of headers; and the use of white space and page layout to emphasize structure. Good lecturers use a variety of techniques to make their structure more explicit and memorable and to reduce the cognitive load in other ways (e.g., by using a great deal more repetition than editors of the written text would tolerate, by explicitly stating the structure of the talk early and often, and by summarizing the argument so far).

In T-560, as in other courses, we seek to provide cognitive and structural supports during the lecture. PowerPoint slides, for example, are a nearly constant accompaniment to the lecture. We use such slides in two primary ways. First, the slides are used to clarify and make explicit the structure of the talk. Most teachers of public speaking rightly criticize the wild overuse of slides in "bullet-point" mode, where speakers essentially read their slides to the audience, often to the detriment of content and meaning (Tufte, 2003). Even though we are sometimes guilty of that as well, PowerPoint slides are most frequently used in T-560 to introduce a new topic or to summarize a previous section. That is, they provide the structure but not the substance of the presentation.

During the main part of lecture presentations, the slides are primarily graphic or visual: They are an alternate representation of the content and a complement to it rather than a restatement of what has been said verbally. In particular, we attempt to use slides that capture the power of graphic images over text, including the ability to clarify and emphasize relationships between facts, concepts, ideas, principles, and

processes. The primary power of images is exemplified well in a graph. A quick glance at a graph provides a rich and explicit exposition of the relationships between several variables or sets of things. Providing that same exposition through words is extremely labor intensive and often too opaque. Other images, such as a photograph or video, have the same privileged capacity to convey relationships of interest. For example, an elephant's size relative to a zebra's is much easier to convey in an image than in words. In addition, we try to provide a structural context within slides, such as a header at the top of a graphic slide. The header is a reminder, an element of structure that reminds the student that we are looking at examples of, say, good Web site design or the limits of sound. In a more subtle way than bullet points, we hope to provide structural supports that help students follow and make meaning of the presentation.

These and other means are used to make lectures more accessible to a wide variety of students. In our impression, most students like these alternatives, whether or not they have any disabilities that may require their use. In that way, they exemplify good universal design when taken as a whole.

Discussion Groups and Universal Design for Learning

Discussions are often seen as a supplement to lectures or a complement to assigned texts. For some students, especially students with learning disabilities, the format of small-group discussions is more accessible than lectures or books. The highly interactive nature of small groups, when facilitated correctly, overcomes the passivity of lectures and books; makes material more relevant and engaging for many; and provides the potential for complex, active, group-based construction of knowledge rather than simple delivery of information. For those reasons and many others, it is beneficial to provide discussion groups as components in any course, both as a complement to and an alternative to the other media. Yet small group discussions are also a limited medium for some students. With this in mind, we also apply UDL principles to discussion groups using the following approaches.

First, students may choose among different discussion groups offered during the week. In addition, all discussion groups are optional: Students may choose any, all, or none, although it is one of several ways to fulfill participation requirements (taking notes is another). In practice, some students come to many sessions, some to only a few, and some to none. The sessions differ in several cognitively meaningful respects; however, we have noticed that some students base their choices on the entirely social aspects of who is in the group or who is leading it.

There are *review* sessions, where students have an opportunity to ask questions about the material for the week, participate in guided review discussions of the week's content, discuss implications or highlights of the material, express concerns, and so forth. These are ideal for students who find the content of readings or lectures either too challenging or too abstract. It is also a good place for students to inquire about gaps in background knowledge they may be missing (e.g., some students who are not K-12 teachers may want to know more about lesson plans when we talk about designing curricula).

An alternative is sessions that are called *advanced*. In the advanced sessions, the teaching staff assume students have already read and understood the material for the

week and, therefore, discuss something that extends or challenges that material, more deeply connecting it to other knowledge or ideas. In these sessions an additional relevant reading is assigned that is provocative, new, stimulating, controversial, or even contrary to material otherwise presented in the course. Students must read the extra reading before coming to class. Typically about 10–15% of students show up for these kinds of sessions in a given week, although about 25% of students participate in them over the course of the semester. These are ideal sessions for students who find the lectures or readings too elementary or concrete.

Another way in which the discussions differ is in the medium used for participation. Each week students may choose to join either a face-to-face group or an entirely online discussion group (offered as a component of the course Web site). Students differ significantly in terms of the kinds of discussions they consistently prefer. Some students join only face-to-face groups, never participating online. Others choose just the opposite, and some come randomly or attend both types.

We have not done research to understand the basis of the students' choices. Some things seem obvious, though. Students with dyslexia tend to come to face-to-face sessions rather than write online. Students who are constitutionally or culturally shy seem to prefer the online discussions. What is clear is that the medium very significantly biases student participation. Without the opportunity to participate in discussions online, many students are underrepresented in their ability to show what they know, or they experience barriers to engaging in meaningful dialogues about the course material.

By providing options and multiple means for those discussions, we have found higher rates and quality of engagement in these aspects of the course. In our review of the 2004–05 year, we came to the conclusion that all our sessions, both live and online, would be enhanced by providing specific topics or activities that made them more coherent. As a result, we will try to use the discussion sections to emphasize an alternative way of engaging in the course content by using case studies.

Textbooks and Universal Design for Learning

Books and other texts are not a promising foundation for UDL because they are inherently inflexible. The product of mass production, books are designed with a uniform display and identical content for every student. In addition, most books are delivered to colleges and universities in print, a technology that is particularly difficult to modify and thus to meet the needs of many students with disabilities. As a result, books as they are presently delivered create barriers rather than opportunities for many students. Nevertheless, they are popular in universities (and we like them for their virtues, not their liabilities), so in T-560 we use books. For the most part, we use books in typical ways: three or four books assigned and suggested for purchase, with others on a recommended list. Two are textbooks, and the others are trade books or topical readings on education, media, and neuroscience.

When the reading list is distributed, students notice one thing immediately—the two textbooks seem to cover the exact same topic of introductory cognitive neuroscience. Moreover, the syllabus recommends that students purchase and read only one of them. But which one? That choice is left to each student. This is the first place in

the course that students typically begin to confront alternatives (while developing an understanding of UDL firsthand). Some are charmed by the choice of alternatives and others become alarmed. For some, the fact that either book will suffice does not square with the ways they have been taught to use textbooks. Whereas there is likely considerable overlap between the books, every student knows that there will be topics, ideas, names, facts, experiments, or methods in one that are not in the other at all. One of the books is even much thicker than the other, so how can one even think about buying the thinner one—maybe critical information is left out?

Students soon note, and we also point out, that the books are really different not only in the content they present but also in the way they present the content. One book by Banich (2004) has a great deal more words and is much thicker. It is a highly literate, very well-written and -researched book that is authoritative and scholarly, with occasional illustrations. The main thrust is clearly in the text. The other book, by Carter (1998), is highly visual, loaded with drawings and diagrams. It is thinner than Banich, with fewer words but many more diagrams, illustrations, color, graphics, and maps. Having noticed the differences, students are encouraged to buy the one that seems best for them. Typically, Carter's book sells a bit more. Students are encouraged to borrow each other's books, compare them, and get the best of both, and some clearly do that. A few buy both books. Regardless, this first choice sets the right stage for the course. It is not that either book is perfect, has the "truth" of cognitive neuroscience, or has the right way to present information for all students. Instead, students are confronted right from the start with the fact that they might not all like their information presented in the same way. It's a start.

Later there are other choices about books. One of the books, *Teaching Every Student in the Digital Age: Universal Design for Learning* (Rose & Meyer, 2002), is available at the bookstore and library as usual. With the permission of the publisher, however, the entire book is also available on the Web absolutely free at <http://www.cast.org>. Nonetheless, most students choose to purchase it in print. For most students, reading a whole book online is not a positive experience. The print version is more convenient, more readable in the long run, and more familiar. Most of the students in this class are adult graduate students, immigrants to the land of digital books instead of natives. However, some students are very pleased to read the book entirely online. These students, including those with dyslexia or those who are blind, for example, do not find that the print version is more convenient, more readable, or more comfortable. For them, it is much better to read the book online using a talking browser. Other students, like those with attention deficit disorder/attention deficit-hyperactivity disorder (ADD/ADHD) or those who are computer-savvy, prefer the online book because they enjoy exploring the format, especially embedded links, which foster connections to relevant material that may not be as easy to access through a print version.

Not all the course books are available in this alternative fashion yet. As a result, students who have dyslexia typically approach the disability services office to scan the printed books into digital versions that they can use. This is an unfortunate, time-consuming, and expensive workaround to overcome the limitations of print, but that will soon change.

In 2004, the U.S. Department of Education endorsed, both houses of Congress passed, and President Bush approved a revision of IDEA that included a new policy: the National Instructional Materials Accessibility Standard (NIMAS). NIMAS stipulates that publishers must provide a digital source file of their printed textbooks to a national repository at the time print versions are distributed. Furthermore, states must distribute accessible versions of those source files to their students in a timely fashion. NIMAS is valuable because it specifies the format (an XML base with DAISY tags) in which those textbooks must be provided. This makes it vastly faster and easier to generate many types of accessible and digital versions, and the format is consistent for all publishers and for all states and districts.

Officially, NIMAS only applies to preschool, elementary, and secondary education. However, the popularity of NIMAS among states and publishers alike has led many colleges and state systems, as well as publishers, to consider adopting the NIMAS standard for postsecondary use as well. However, these ideas have yet to be implemented in any formal or systemic way. Soon, we believe that there will be readily available textbooks in both print and digitally accessible versions.

Multimedia, the Course Web Site, and Universal Design for Learning

Text and textbooks are a limited presentation medium. In the T-560 course, we try to include a richer set of media as alternatives. The use of video for lectures is an example, but the simplest expansion of media comes from using the Web as the basic skeleton for the course.

The course Web site is central to the course in many ways. It serves as a frame that holds the syllabus, the assignments, the discussion groups, the projects, the class notes, the class videos, the PowerPoint slides for the lectures, and much more. For each week, there are also links to many Web sites, which are presented as additional representations of the topic for the week, or as scaffolds and supports for student learning.

Although in general there are many low-quality materials on the Web, some Web sites are extremely informative and relevant to our class. An advantage of Web sites is the rich set of media from which they are constructed. As an example, one of the course lectures draws heavily on understanding optical illusions. While there are typical examples of illusions in both textbooks, there are several extraordinary Web sites devoted entirely to understanding illusions. These Web sites have extensive collections with accompanying explanations. Moreover, the range of illusions is far more extensive and dramatic than those available in print. For example, illusions of movement or sound cannot be captured in text. During the lecture, which is always done with a live connection to the Web, some of the more dramatic illusions are exhibited and discussed.

In the course Web site, the multimedia syllabus conveys not only the text readings for the week but also the Web sites and other media, all available for easy access through simple clicks of a mouse. These alternatives are mildly engaging for some students, but for others this chance to explore course ideas in a broader and richer context is very important. In fact, for some who were born in a different generation from

their professors, this use of contemporary media seems essential for relevance and comprehensive understanding.

Assessment Methods for the Course

It is not enough, of course, to use the framework of UDL only when considering how to present and teach methods, information, or skills. It is also essential to consider UDL as a framework to guide the design of another critical element of instruction: assessment. In considering assessment, we will focus on the second principle of UDL: providing multiple means of action and expression. The other principles are clearly part of assessment, but for brevity we will focus on the obvious fact that assessment draws heavily on the ways students are required to demonstrate and express what they know. From a UDL perspective, it is essential to provide multiple means for that expression.

There are many assessment techniques, the choice of which should be aligned with and constrained by the goals of the course. In our course, we want to develop students who not only can recognize UDL in practice but also can express that knowledge in action. Whether they are designing a curriculum or workshop, choosing from among a number of available curricular options, or preparing to teach a single unit or lecture, we need to know whether they can effectively apply what they have learned. Is it usable knowledge? Administering multiple-choice tests or essay questions is not likely to be an adequate measure of those abilities, nor is writing a traditional paper about how they might apply what they have learned. As a result, we require that students complete two projects on which they are graded.

Midway through the course, students prepare and submit a midterm project that requires them to review the research literature on one type of learner (of any age level, including adults) and to create a Web site. Students are encouraged to choose an atypical learner as their focus. While *atypical* is usually associated with a disability of some kind (e.g., dyslexia, autism, ADD/ADHD, Turner's syndrome, Williams syndrome.), past projects have focused on other types of atypical learners, including those for whom English is a second language and those with gender dysphoria. Students research current neuropsychological literature to identify what is known about the underlying neurology of that type of learner and to articulate their resulting strengths and weaknesses for that learner in a specific subject or educational setting (e.g., dyslexic students in a fifth-grade science lab).

Traditionally, the results of such student research are presented via a 10-page paper. However, the second principle of the UDL framework encourages greater flexibility in the means students can use to express what they have learned. As a result, students in T-560 can use not only text but also images, sound, video, the Web, and so forth. To stimulate their expressive palette somewhat, we artificially limit the word count to approximately 1,500 words. We do that because most students, left to their own devices, tend to limit themselves to text because it is most familiar to them as an academic medium; with a low word limit, they must rely on alternative means to convey complex reviews of neuropsychological research and their conclusions. For some students an expansion of possibilities is a bit threatening, for others the broader palette is very appealing.

When finished, all students must submit their projects in the form of a Web site that then becomes part of an online learning network where all students' Web sites are linked to each other. This manner of submitting work is very challenging for some students, and many have never before created anything on the Web. Nonetheless, we have chosen to use the Web rather than paper as the vehicle for presentation for several reasons.

First, the Web provides a rich and flexible foundation for using multiple media. Students can use a rich variety of other media besides text. Second, the Web provides a way for students to learn from each others' work. Whereas papers have a limited audience of the professor or teaching assistant, all members of the class can access projects on the Web site. Not only is this more motivating for students, it is also more instructive. Each year we see tremendous learning that derives from this ability to view each other's work. In fact, we now emphasize this type of collaborative learning by encouraging students to link their projects to those of other students. Particularly in the final projects, in which students design a lesson or curriculum that considers the profile of the learner in their first projects (and reflects the principles of UDL), students take great advantage of other students' work as part of background research for their own projects. But even more apparent is the explosive effect of particularly strong projects, especially ones that take good advantage of multiple media. The contagion of best practices is easily apparent because high-quality student projects serve as terrific, highly relevant models to emulate and learn from.

How are these public and nontraditional projects graded? Each year students ask anxiously if we will grade on presentation or layout, as opposed to content. Most hope that we will not, primarily because they realize that some students in the class have highly developed skills as Web or media designers. (Some students in the class are majoring in media design.) Thus, some students may be at a considerable advantage in their presentation skills, and this realization usually sparks an important dialogue in class. Inevitably some students, usually students with dyslexia or who have English as a second language, raise the opposite point of view, hoping that presentation will indeed count. For them, the increased palette has leveled the playing field for the first time in their academic careers, and they are delighted to finally have an outlet that more accurately reflects their abilities.

Eventually they learn that presentation does count. Certainly we are forgiving for beginners, but we stress that even beginners can make good choices about the kinds of media that are optimal for expressing different kinds of knowledge. And we provide, in a UDL way, many different ways for students to get support in making their presentations effective; that is, multiple ways to support expression.

Three types of support are customary. First, we give plenty of models. For the first project, models from the previous year's class are typically used. For the second project, there are plenty of models from the first projects of their peers. Second, we provide multiple scaffolds. We offer labs or sections where students can come to learn the basics of both Web design and the use of databases to find relevant literature. In the 2005–06 year, for the first time, we encouraged the students with advanced Web design skills to offer these labs as part of their participation credit, which was a big hit for both instructors and students. All the labs are at different skill levels, so students

can learn from any level of prior knowledge. We also encourage students to work collaboratively, and they do, even though they are each responsible for their own Web site. Students who are skilled at media design, even though they may not be knowledgeable in neuroscience or skilled in writing, turn out to be very popular as peer collaborators with educators and researchers who may know how to read a Web page but have never designed one. In a complementary way, students who have excellent backgrounds in education, neuroscience, or research are also popular collaborators for media designers struggling with the class content. The two projects—presenting research and then planning a lesson—draw on the varied strengths of students in the class, giving everyone a chance to have background knowledge and come to the fore.

Affect and Engagement in T-560

From a UDL standpoint, there is a final concern: Does the course succeed affectively, engaging the students? Does it engage different kinds of students? Is that engagement sustained in changes in practice? Overall, there are indications that the course engages a reasonably broad range of students. For one thing, the course is quite popular. This is especially notable because it requires a considerable amount of work in difficult subjects, it is not required for any degree concentration, and there is no special education major at Harvard. What attracts students?

We believe that one of the significant attractions of the class is its attempt to respond to individual differences, providing multiple ways of presenting information, and allowing students to respond. Of particular importance, especially for adult learners, is the ability to make choices (e.g., Cordova & Lepper, 1996).

In the course, as we have noted, students experience choice in almost every arena: choices in the textbooks they choose to read, the kinds of media they prefer to learn from, the timing and level of discussion groups, the media mix they use for their projects, the format for discussions, the amount of support they prefer, and the ways to interact with materials. For some students there are still too few choices, and for some there are too many. But overall, the very fact of choice is a tremendous source of attraction and motivation in the course.

There is a second way that choice is important: in terms of the faculty and teaching assistants. Because there are multiple means of interaction in the course, there are choices for the faculty as well. Throughout the course, we emphasize the different areas in which we members of the teaching staff each have strengths and weaknesses (e.g., content areas, Web design, pedagogical strategies). This *distributed intelligence* eliminates the onerous effects of having to be everything to everyone. It also models for students the value of collaborative teaching and learning. To some extent, the instructors choose the kinds of interactions with which they are most comfortable, and at times they choose situations in which they will be challenged to learn relatively new information or skills with the support of other instructional staff, placing them in the best positions to succeed and to feel engaged.

Last, it is important to emphasize a secondary benefit of universal design. Because there is a richer media mix in the course than in many others, there are opportunities to specialize. It is very clear that, over the previous five years during which the alternative media became more prominent, the lectures have become better. Essentially,

just as radio differentiated from television and became more popular in the process, the lectures have been able to differentiate from the other course media. Lectures are used less for information dispensation and more for teaching, modeling, emphasizing, and connecting. They are used more for the kinds of things for which they are optimal.

CONCLUSION AND RECOMMENDATIONS

There are two broad kinds of solutions for addressing the problems of individual students, including those with disabilities. On one hand, the problems can be considered *individual* problems (e.g., the student has a disability that interferes with the ability to access course content, to express knowledge, or to engage optimally in it). Such a view fosters solutions that address weaknesses in the individual. On the other hand, the issues can be considered an *environmental* problem in the design of the learning environment. For example, the typical overreliance on printed text for presenting content and evaluating students clearly, and differentially, raises barriers to achievement for some students and privileges others. Such an environmental view fosters solutions that address the limitations of the learning environment rather than the limitations of the student, while making the student less of a problem and more a part of diversity within the course. The advantage of such universal solutions is that, as with such approaches in built environments, they are very likely to be useful for many individuals: Built once, they are applied many times.

We believe that both approaches are important from a pedagogical standpoint. In their intersection, moreover, we will find solutions that are not only more economical but also more ecological. They reflect the fact that disabilities always reflect mismatches between the environment and the individual. Right now, we believe that universities place too much emphasis on the disabilities in students and not enough on the disabilities in the learning environment. Accommodations and access issues are largely addressed on an individual basis rather than on the level of courses, departments, or universities. Universal design presents other options and perspectives on access that ultimately will benefit all students, disabled and nondisabled.

REFERENCES

- Banich, M. (2004). *Cognitive neuroscience and neuropsychology* (4th ed.). Boston: Houghton Mifflin.
- Carter, R. (1998). *Mapping the mind*. Berkeley: University of California Press.
- Cordova, D. I., & Lepper, M. R. (1996). Intrinsic motivation and the process of learning: Beneficial effects of contextualization, personalization, and choice. *Journal of Educational Psychology*, 88(4), 715-730.
- Rose, D. H., & Meyer, A. (2002). *Teaching every student in the digital age: Universal design for learning*. Alexandria, VA: Association for Supervision and Curriculum Development (ASCD). (Also available in digital format at <http://www.cast.org>).
- Tufte, E. R. (2003). *The cognitive style of PowerPoint*. Cheshire, CT: Graphics Press.